Assessment of the safety climate in outpatient diagnostic services: Development and psychometric evaluation of a questionnaire

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Abstract: INTRODUCTION Safe practice and safety culture are important issues in outpatient diagnostic imaging services. As questionnaires assessing safety culture through the measurement of safety climate in this setting are not yet available, the present study aimed to develop and validate such an instrument. MATERIALS AND METHODS After adaptation of an existing questionnaire and qualitative pretesting, the instrument was tested by collaborators from three outpatient imaging services in Switzerland. Results were first assessed using descriptive statistics. Scores of individual services were compared using a Wilcoxon test assessing differences between rank distributions. The final instrument was tested for validity using inter-rater agreement measures, such as reliability within groups (r), and an intraclass correlation coefficient measure (ICC(1)). These measures allowed the assessment of validity of aggregation into a total score (r) and validated the instrument for its capacity to distinguish various safety climates of different groups by comparing inter-rater agreement in the overall sample to inter-rater agreement of individual services (r) and by measuring group effects (ICC(1)). Furthermore, the final instrument was tested for internal consistency and reliability using Cronbach's Alpha. RESULTS Safety climate scores vary significantly between services. Inter-rater agreement measures show that item aggregation is justified and that the instrument distinguishes various patterns of safety climate. The final instrument proves to be valid, consistent and reliable. CONCLUSIONS The final instrument presents a valid, consistent and reliable option to measure safety climate in outpatient diagnostic imaging services. Results can be used as a basis for quality improvement. KEY POINTS An adapted questionnaire that assesses safety climate in outpatient diagnostic imaging services was developed and tested in Switzerland.
• Psychometric evaluation showed the questionnaire to be a valid, consistent and reliable instrument.
• Results are of interest for imaging services as well as for stakeholders interested more globally in monitoring and quality improvement.

DOI: https://doi.org/10.1007/s00330-018-5646-1

Development and Psychometric Evaluation of a Questionnaire for the Assessment of Safety Climate in Outpatient Diagnostic Imaging Services

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Abstract

Introduction: Patient safety is an important issue in outpatient diagnostic imaging services. The present study aimed at developing and validating a questionnaire assessing safety climate in outpatient diagnostic imaging services, while taking into account specific aspects of patient in this context.

Materials and Methods: After adaption of an existing questionnaire and qualitative pretesting, the instrument was fielded with collaborators of three outpatient imaging services in Switzerland. Results were first assessed using descriptive statistics. Scores of individual services were compared using a two-sided two-sample Wilcoxon test. The final instrument was tested for validity using interrater-agreement measures rwg(j), rwg and ICC(1). Validity of item aggregation was measured using rwg(j). Further, validity was tested comparing rwg of individual services with the overall rwg and with the hypothesis that rwg should be lower in the overall sample than for individual services. ICC(1) was used to measure whether a group effect was present. Further, the final instrument was tested for internal consistency and reliability using Chronbach's Alpha.

Results: Safety climate scores vary significantly between services. Values of rwg(j) allow for item aggregation. Interrater agreement proves to be lower in the overall sample than for individual services and a group effect is present, thus showing that the final instrument is valid. Further, the final instrument proves to be consistent and reliable.

Conclusions: The final instrument presents a valid, consistent and reliable option to assess safety climate in outpatient diagnostic imaging services. Results can be used as a basis for quality improvement.

Key words

- Outpatient service
- Radiology
- Safety
- Psychometrics
- Organizational Culture
- Surveys and Questionnaires

Key Points

- An adapted questionnaire assesses safety climate in outpatient diagnostic imaging services.
- The questionnaire was developed and fielded in Switzerland.
- Psychometric evaluation showed the questionnaire to be a valid, consistent and reliable instrument.
- Results are of interest for imaging services as well as for but also for stakeholders interested more globally in monitoring and quality improvement

Introduction

In parallel with the healthcare sector in general, the use of diagnostic radiology services has grown in Switzerland during the last years. From 2010 to 2016, the number of board-certified radiologists rose from 647 to 856 (+32%), while the number of inhabitants per radiologist dropped from 11’593 to 9’836 (-15%) [1]. Concerning the outpatient sector, generated costs rose from 400 Million Swiss Francs to 873 Million Swiss Francs in the same time-period [2]. As a result, strong competition between the different services developed with each service trying to maximise the operating grade of their infrastructure as much as possible. This situation is further tightened by a revision of the Swiss outpatient reimbursement system, leading to a considerable reduction of profits for a series of diagnostic imaging procedures [3]. In consequence, imaging services’ staff might work for longer hours, run shorter imaging protocols and/or reduce manpower in order to keep the services at their current return on investments. However, this might have a negative impact on patient safety.

As prior field observations conducted by one of the authors, but also literature suggests [4], patient safety is not only influenced by radiographers and radiologists but also, to an important extent, by patient administration staff. Indeed, staff administrating referrals, planning slots for examinations, scheduling patient appointments as well instructing patients on preparation for the examination, inherit an important role for patient safety. To a certain degree, this is similar to the triage performed at the phone in physicians’ outpatient offices [5]. But in contrast to general medical offices, patient administrative staff in out-patient diagnostic imaging services often does not have any medical education.

Assessing and comparing patient safety across services in a way that respects specific safety issues is gaining more and more importance for services themselves

but also for stakeholders interested more globally in monitoring and quality improvement. One way to assess safety culture is to measure safety climate as perceived by staff. Safety climate may be defined as shared perceptions or attitudes about the norms, policies, and procedures related to patient safety among members of a group and points to the underlying concept of safety culture, measuring, so to say, its surface. [6, 7] Still, an instrument measuring safety climate specifically in outpatient diagnostic imaging services is to the best of our knowledge not yet available.

The measurement of safety climate by questionnaires has first been developed for inpatient settings [8, 9, 10]. Some of the instruments like the Hospital Survey on Patient Safety (HSOPS) [11], the Safety Attitude Questionnaire (SAQ) [12], or the Culture of Safety Survey (CSS) [13] have been adapted to a German or Swiss context [14, 15, 16]. However, these instruments inherit several weaknesses when it comes to out-patient settings [17]. First, outpatient radiology services are often considerably smaller than inpatient settings. Thus, questions related to management or the relation between departments are difficult to answer. Second, the patient population in outpatient services significantly differ, for example in terms of morbidity, compared to inpatient settings. Safety issues might thus be quite different. Third, these questionnaires strongly focus on medical staff, largely ignoring the important role of administrative personnel without a medical qualification.

Especially the last point often remains an issue when instruments are adapted to outpatient settings and even when they are directly developed for outpatient settings [18, 19]. For example Modak et al. [19] report that radiographers, referral coordinators or outpatient administrative representatives did not answer many items of the SAQ adapted to outpatient setting. Instruments specifically developed for imaging services focus on radiology-specific issues such as magnetic resonance

imaging [20] and again largely exclude patient administration staff. The SafeQuest, however, which was developed by de Wet et al. [21], is designed to suit both medical as well as administrative staff issues and was specifically created for outpatient services. In their validation study, 35% of respondents classified themselves as being administrative staff [21]. Having been recently translated into German by the AQUA Institute (based in Göttingen), this survey was chosen as basis and adapted to the needs of Swiss outpatient diagnostic imaging services.

The present article describes the adaption and validation of the SafeQuest survey instrument for outpatient diagnostic imaging services. The aim was to develop an instrument that is able to assess and compare safety climates across services in a valid, consistent, and reliable way.

Materials and Methods

Questionnaire development

The designing of the questionnaire was part of a broader initiative, aiming to develop quality indicators for outpatient imaging services. The initiative and the development of the questionnaire was organized by the EQUAM foundation (based in Bern). First, the German version of the SafeQuest was compared to its English original and some adaptions to the Swiss context were made. In order to keep the instrument applicable to all groups of staff, no questions about safety concerning specific examinations were added. After that, a qualitative pre-test [22] was conducted with two radiologists, two radiographers, and two persons working in patient administration and was adapted accordingly. Thereafter, the instrument was applied for the first time to a sample. Survey items are presented as statements asking for the degree of agreement on a seven-point Likert scale ("In how far do you agree to the following statements?" "not at all" to "to a very great extent"). The questionnaire was composed of 30 items and was organized using de Wet et al.'s [21] thematic structure (see table 2 for a list of all items). In addition to that, respondents were asked to provide demographic data, namely gender, profession, number of years of professional experience and number of years of employment at the respective service.

Sample and Procedures

The questionnaire was fielded as online survey and invitations for participation sent to 124 individuals, including employees as well as (co)owners of the services, working at three outpatient imaging services in the German-speaking part of Switzerland. Recipients were asked to complete the questionnaire within two weeks. Participation was voluntary and anonymous. Recipients who had not answered within a two-week period received a reminder.

Statistical Methods

Descriptive statistics (means, distributions, missing answers) assessed the quality and distribution of data. An individual mean score was calculated for each respondent by aggregating all of his/her questionnaire's item ratings. Total mean scores and their corresponding distributions were calculated as the overall mean scores and distributions of the individual mean scores. Negatively worded items were reversely coded to ensure that higher scores indicated a more positive assessment of safety climate for every item.

Differences between services were assessed by using a two-sided two-sample Wilcoxon test, also known as Mann-Whitney test [23, 24] applied to the distribution of the individual mean scores of the questionnaire. A test result <0.05 was regarded as statistically significant.

Content validity was assessed using rwg(j) and rwg as measures of interrater agreement. These measures compare observed variance in ratings to the variance one would expect when answers would be random and thus measure within group agreement [25, 26, 27]. Rwg ranges between 0 and 1, with higher values indicating stronger agreement.

As Ginsburg et al. [27] describe, rwg(j) measures agreement through all items of a questionnaire and thus is a good indicator to assess whether item aggregation to total scores is valid. Smith-Crowe et al. [28] give significance levels for questionnaires up to 10 items. For instruments with 10 items, 100 respondents and 7 categories, coming the closest to our present instrument, an rwg(j) of 0.63 is claimed to be sufficient for aggregation to a total score.

Rwg on the other hand measures interrater agreement on the level of total scores of questionnaires. This measure was used to compare interrater agreement specific for each service to interrater agreement among all respondents. The hypothesis was that if our instrument proved to be valid, it should be able to distinguish specific safety climates of various services. Thus, rwg among all respondents should be lower compared to that measured for each service. Further, the comparison of rwg across services allows not only to compare safety climate level, but also to compare safety climate strength [27, 29]. Indeed, the rwg as a measure of interrater-agreement

shows in how far the perception of a certain safety climate level, as typically measured by the mean, is strongly present in a service.

Additionally, the validity of the instrument was measured using the Intraclass correlation ICC(1) measure. This measure estimates the effect that a certain target, in our case the fact of being a collaborator of a certain service, has upon the ratings of respondents [27, 30]. According to Ginsburg et al. [27], an ICC(1) > 0.05 shows a group effect and thus allows to confirm that an instrument measures the safety climate perceived by a certain group of individuals.

Internal consistency and reliability were measured with Cronbach's Alpha [31]. This measure can be viewed as the expected correlation of two tests measuring the same construct, varying between 0 and 1. A value of > 0.7 was regarded sufficient.

All analyses were performed with the Open Source Software R, Version 3.4.3 from 2017 [32].

Results

In total, 106 questionnaires were returned, resulting in a response rate of 86% (106/124). Three questionnaires were excluded due to excess missing data yielding a final sample of 103 completed surveys (83%). Table 1 summarizes the study sample's basic characteristics. As can be seen, the sample includes one bigger and two smaller outpatient radiology services. Most of the respondents were women with more than 10 years of working experience, who have been working in the current out-patient service between one and five years. Most respondents identified either as radiographers or as working in the services' patient management (Table 1)

Descriptive Statistics, Aggregation and Safety Climate Levels and Strength

In total, 87% (90/103) of the questionnaires had all safety climate items answered. None of the items presented more than five missing answers for the questions about safety climate. Analysis of distributions showed coherent answering behaviour also for reversed items. Therefore, all questions are included in the final instrument and analysis.

Table 2 summarizes the results of the final instrument and provides both total scores as well as individual scores of the services. Analysis for the entire sample revealed the highest score for the statement: "The quality and safety of patient care in the service is taken seriously", with a mean of 6.0 on a seven-point Likert-scale. In individual analysis within the three services, this statement ranged between the top- to the third highest score. The statement: "The service is a good place to work", received the second highest score (5.9), based on answers from all services. Within the 3 services, it ranged second for service 3 and 2, and eighth for service 1. The second highest score (5.9) was also obtained for disagreement with the statement:

“Collaborators frequently disregard rules, protocols and procedures.“ This item scored fourth for service 1, sixth for service 2, and fourth for service 3.

In contrast to that, the statements “The service leadership communicates its long-term plans for the development of the service”, “Collaborators always have enough time to complete work tasks safely” and “The opinions of all concerned collaborators are taken into account for the development of processes” scored lowest with an overall result of 4.2 on a seven-point Likert-Scale. These items ranged among the lowest four scores for the individual services, except for the second item for service 2 and the third item for service3 (Table 2).

The rwg(j) for the questionnaire was 0.94 for the 90 completely filled in questionnaires, thus allowing for aggregation to total scores.

The total mean score for the overall sample was 5.0. Between the outpatient services, the total mean scores ranged from 6.1 for service 1 to 5.1 for service 2, and 4.7 for service 3, respectively.

The two-sided Wilcoxon test for the difference between rank distributions was significant for differences between out-patient service 1 and 2 with a p-value of 0.0003 and between services 1 and 3 with a p-value of <0.001. The test showed no significant difference between service 2 and 3, with a p-value of 0.12. Figure 1 shows the distributions of individual mean total scores for each service (Figure 1).

Validity, Internal Consistency and Reliability

The rwg ranged between 0.83 for service 1, 0.77 for service 2 and 0.71 for service 3, while the overall rwg was 0.68 and thus smaller than the rwg for each individual service.

The ICC(1) was 0.27 , therefore, pointing to a group effect. Cronbach’s Alpha was 0.97 with a 95% confidence interval ranging from 0.96 to 0.98.

Discussion

The present study aimed to develop a valid, consistent and reliable questionnaire assessing safety climate in outpatient imaging services.

The response rate was high and the rate of missing answers was very low. Given that the survey was voluntary and anonymous, these results suggests that the statements are easy to understand and relevant to respondents. Of notice, the great proportion of staff working in the call center and in administrative functions responding to the questionnaire underlines that the instrument is adapted to this professional group, thus avoiding the weaknesses of other instruments [17, 19].

Statements which scored high both in the overall as well as in the individual analysis, indicate high safety climate levels for certain elements. The three highest-ranking items rather describe general impressions on the priority of patient safety and quality as well as the workplace quality and culture.

On the contrary, lower scores were achieved regarding employees' involvement in the service's long-term development and improvement of processes. Also, time management is an issue in the participating out-patient imaging services. This might indicate a mounting pressure upon services' staff with regard to increasing competition between different imaging services and monetary constraints after revision of the outpatient reimbursement system. Moreover, to closely monitor the evolution employees' involvement in processes but also the pressure under which staff is working can be of great interest; for the services themselves but also for stakeholders, who are in general interested in quality improvement.

The high value for the interrater agreement measure rwg(j) shows that the instrument is indeed measuring a consistent concept, namely safety climate perceptions. On this basis, total scores can be calculated and compared between services or groups of staff.

Our results show differences in total mean scores and significantly varying overall distributions between the three services. Moreover, a higher mean score and distribution corresponded with a higher score for the interrater agreement measure rwg. According to literature [27, 29], it can thus be stated that service 1 incorporates a comparatively high and strong safety climate, while service 2 shows an intermediate and service 3 a relatively low level and strength of safety climate. For radiology services, such results can be of interest for further analysis. For instance, a low interrater agreement can lead to closer examination of potential differences between professional groups or employees with more or less working experience. High interrater agreements on the other hand indicate a consistent agreement upon a certain climate level. Interventions aiming to improve safety culture can be based on such an evidence and can be specifically tailored to certain groups and/or issues. Comparison between interrater agreement of each out-patient service versus interrater agreement of the overall sample using the rwg measure reveals that the present instrument is able to measure differing safety climates of individual services. The intraclass correlation measure further strengthens this idea by showing a correlation between the results and the membership to a certain services' team. The instrument thus allows services and regulators to monitor effects of organizational change, for example on staffing or upon safety climate.

Cronbachs Alpha proved to be at a sufficient level, confirming that the final survey instrument is reliable and consistent.

To the best of our knowledge, this is the first validated questionnaire assessing safety climate of outpatient radiology services as judged by their employees, including personnel working in the call center or administration. However, a certain selection bias could be present as services participating in the study were highly motivated and

already participated in a larger quality improvement project . Generalizability is thus unclear.

The present questionnaire enables the evaluation of the safety climate of outpatient radiology services as perceived by their employees. Results can be used as basis for quality improvement as well as to monitor the future development of the safety climate in the highly dynamic field of outpatient radiology services.

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Legends to Tables and Figures

Table 1. Summary of the study sample's characteristics (n=103).

Table 2. Results (mean and standard deviation (SD)) of the 30 items which were included in the final instrument.

Figure 1. Comparison of distributions of mean scores of the three services

Characteristic	**N (%)**
Imaging service	
Imaging Service 1	18
Imaging Service 2	21
Imaging Service 3	64
Gender (5 answers missing)	
Male	18 (17)
Female	80 (78)
Profession (3 answers missing)	
Radiologist	16 (16)
Radiographer	51 (50)
Patient administration	33 (32)
Years of working experience (1 missing)	
Less than a year	4 (4)
1-5 years	13 (13)
6-10 years	13 (13)
11-20 years	37 (36)
More than 21 years	35 (34)
Years in the service	
Less than a year	14 (14)
1-5 years	44 (43)
6-10 years	22 (21)
11-20 years	16 (16)
More than 21 years	7 (7)

Table 1. Summary of the study sample's characteristics (n=103).

	Total		**Service 1 (n=18)**		**Service 2 (n=21)**		**Service 3 (n=64)**	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Total Score	5.0	1.1	6.1	0.8	5.1	1.0	4.7	1.1
Item								
The performance of collaborators is impaired by excessive workload*	5.0	1.6	6.4	1.0	5.7	1.1	4.3	1.5
Collaborators always have enough time to complete work tasks safely	4.2	1.7	5.6	1.6	4.7	1.4	3.6	1.5
The level of staffing in the service is sufficient to manage the workload safely	4.4	1.8	5.8	1.5	5.1	1.6	3.7	1.7
When pressure builds up, collaborators are expected to work faster even if it means working less accurately*	5.1	1.6	5.9	1.7	5.5	1.6	4.8	1.6
Collaborators feel free to question the decisions of those with more authority	4.4	1.7	5.1	1.4	5.2	1.6	3.9	1.7
Collaborators are comfortable in expressing concerns about the way things are done to the service leadership	4.9	1.8	6.2	1.8	5.3	1.7	4.4	1.7
There is open communication between collaborators, notwithstanding their position	4.6	1.8	5.9	1.5	4.9	1.8	4.1	1.7
Collaborators are kept up to date about service developments	4.4	1.7	5.9	1.6	3.7	1.5	4.3	1.7
The service leadership communicates its long-term plans for the development of the service	4.2	1.9	5.7	1.4	3.8	1.6	3.8	2.0
The hierarchy in the service is a barrier to effective working*	5.6	1.6	6.4	1.8	6.3	1.3	5.1	1.7
Highlighting a significant event will likely result in negative repercussions for the person raising it*	5.8	1.4	6.6	1.5	6.1	1.3	5.5	1.5
The service leadership does not deal effectively with problem collaborators*	5.1	1.7	5.9	1.8	4.9	2.0	4.9	1.5
When collaborators suggest ways to improve processes,	5.1	1.8	6.4	1.1	5.3	1.6	4.7	1.8

the service leadership does not take this seriously*								
There is a low level of trust between practice team members*	5.7	1.6	6.5	1.8	6.0	1.7	5.4	1.7
Collaborators frequently disregard rules, protocols and procedures*	5.9	1.2	6.4	1.0	6.0	1.3	5.7	1.3
Collaborators treat each other with respect	5.8	1.3	6.3	1.7	5.3	1.6	5.8	1.1
Collaborators always support one another	5.7	1.2	6.3	1.4	5.3	1.5	5.6	1.1
Disagreements within the service team are resolved appropriately	4.8	1.5	6.0	1.9	4.6	1.7	4.5	1.5
Collaborators work well together at all positions within the practice	5.0	1.4	5.7	1.0	5.0	1.1	4.8	1.2
The service is a good place to work	5.9	1.2	6.3	1.6	6.2	1.0	5.7	1.1
Collaborators are generally satisfied with their jobs	5.2	1.3	6.0	0.6	5.6	0.9	5.1	1.3
Good teamwork is promoted and considered to be important by the service leadership	5.2	1.6	6.2	1.4	5.2	1.5	4.9	1.7
All collaborators are encouraged to highlight critical incidents that happen in the service	4.7	1.7	6.2	1.6	4.4	1.5	4.3	1.7
Processes help to prevent critical incidents from happening	4.9	1.4	5.9	1.7	4.5	1.2	4.7	1.4
The opinions of all concerned collaborators are taken into account for the development of processes	4.2	1.8	6.0	1.3	4.4	1.5	3.7	1.7
When processes are changing, the services take time to assess risks for patients, collaborators and the service in advance	4.7	1.7	5.9	1.8	4.8	1.5	4.3	1.7
All concerned collaborators have the opportunity to participate in the analysis of critical incidents	4.3	1.8	6.1	0.9	4.4	1.8	3.8	1.7
The quality and safety of patient care in the service is taken seriously	6.0	1.2	6.6	1.6	6.1	1.2	5.7	1.3
The practice supports the continuing educational	5.3	1.6	6.2	0.6	5.1	1.6	5.1	1.6

development of all collaborators								
The service encourages learning from the ideas and constructive critique of collaborators at all positions	4.8	1.6	6.1	1.2	4.7	1.5	4.5	1.6

Table 2. Results (mean and standard deviation (SD)) of the 30 items which were included in the final instrument.